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MEASUREMENTS

PEAK VOLTMETER - MODEL 67

Operating INSTRUCTIONS

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BOONTON NEW JERSEY

OPERATING INSTRUCTIONS

for

MEASUREMENTS MODEL 67

MEASUREMENTS CORPORATION

BOONTON NEW JERSEY

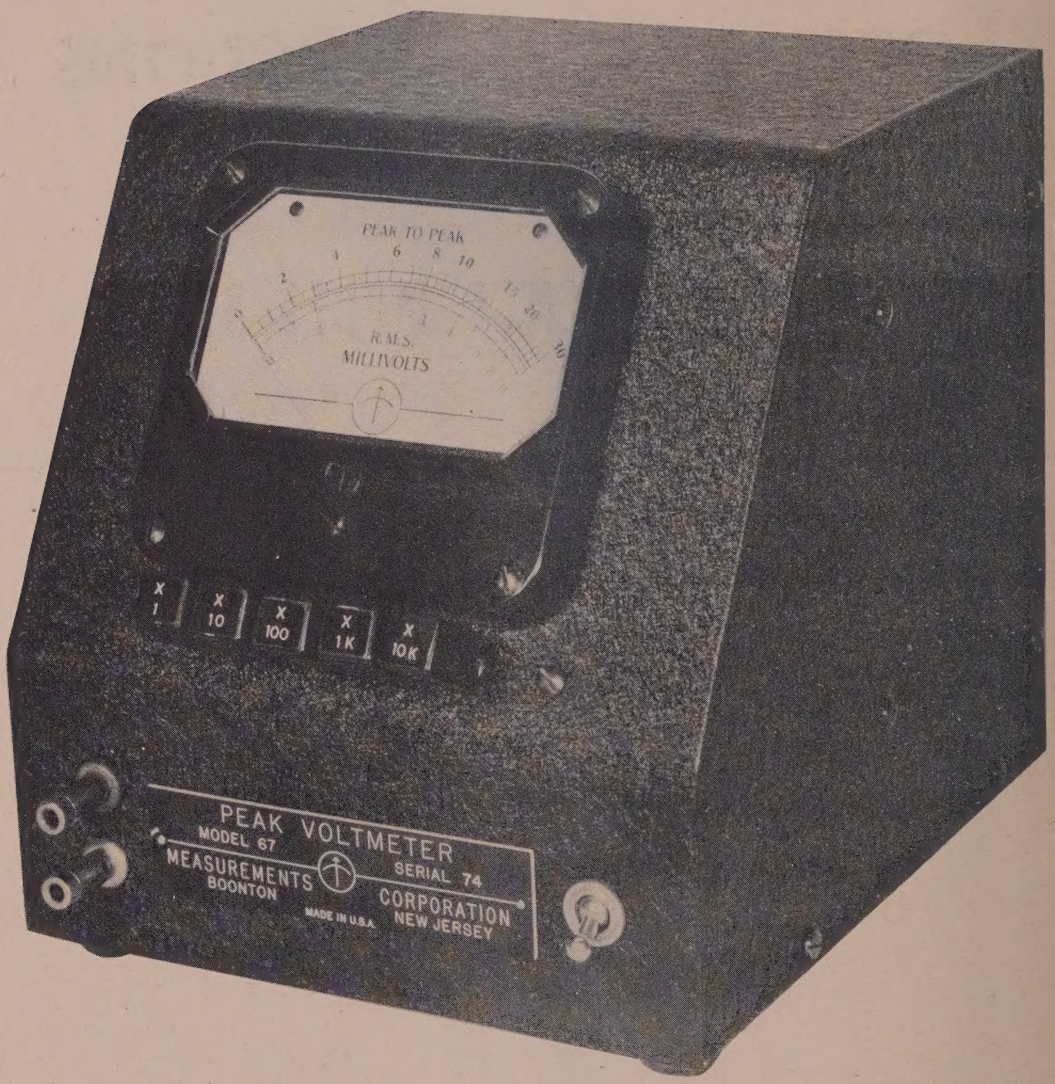

Figure 1 - FRONT VIEW OF MODEL 67

NOTE: THE MODEL 67 NOW HAS CARRYING HANDLE AND PILOT LIGHT. NO METER LIGHTS.

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1. INTRODUCTION

The Model 67 Peak Voltmeter fills a need for a sensitive voltmeter capable of indicating the true peak value of complex waves encountered in radio and allied electronic work.

Copper oxide meters and electronic voltmeters of the r.m.s. type have failed consistently to give satisfactory results in the measurement of complex waves encountered in impulse and ignition radio noise, speech, music, mechanical vibration measurements and video work in that they indicate only one-half to one-tenth of the true peak value of these complex waveforms.

The Model 67 overcomes these limitations and also makes possible many new types of measurements. It indicates the peak-to-peak value of symmetrical and asymmetrical waveforms varying from low frequency square waves to pulses of less than five microseconds duration. Engineers in the rapidly growing field of vibration and stress analysis will welcome the Model 67, as its peak characteristics, low frequency response extending down to 5 c.p.s. and high sensitivity make it possible to operate the instrument directly from strain gauge bridges without intervening amplifiers or carrier systems.

2. SPECIFICATIONS

a. Voltage Range - 5 ranges permitting measurements from .0005 to 300 volts peak to peak. (Approximately 100 r.m.s. volts).

b. Semi-logarithmic scales are hand calibrated; 0 to 30 peak to peak and 0 to 10 r.m.s. equivalent.

c. Frequency Range - 5 to 100,000 sine wave cycles per second.

d. Input Impedance - 1 megohm shunted by 30 mmfd.

e. Recorder Terminals - Self shorting type for external one milliampere graphic recorder or milliammeter.

f. Tubes - Two 6SH7, one 6H6, one 6SN7GT, one VR150/0D3, one 6X5GT.

g. Dimensions - Height - 7½ in.; Width - 7 in.; Depth - 8½ in.; Weight - approximately eight pounds.

h. Power Source - 105 to 125 volts, 50 to 60 cycles, 35 watts.

3. OPERATING INSTRUCTIONS

a. Setting Up

The Sensitive Peak Voltmeter is completely self-contained. Before making power connection, check supply voltage and frequency. Standard Model 67s are designed for operation on 117 volts, 50 to 60 cycles. If the power supply is correct, plug in the power cord and switch on by flipping up the toggle switch on the front panel.

After five minutes warm-up period, the meter should rest on zero, if input terminals are shorted or X10,000 button is pressed.

b. Operation

If measurements are to be made at low signal levels, it is recommended that a shielded cable be employed to connect the binding posts to the circuit under test. Always press X10,000 button before connection is made.

No zero adjustments or other calibration adjustments should be necessary during normal operation of the instrument. If difficulties are experienced, refer to Section Five on service and maintenance in this manual.

c. Use of Recorder

Provision is made for connection of a 1500 ohm, 1 milliampere graphic recorder. If recorders having less resistance than this are to be used, it will be necessary to add enough series resistance to bring up the total circuit resistance to 1500 ohms in order to maintain the calibration.

Neither recorder terminal can be grounded. It should not be necessary to shield the recorder leads unless the instrument

is operated in the presence of very strong radio frequency fields. The recorder terminals are available at the rear of the case. Standard phone-type tip connectors can be used for connection. It is recommended that the power to the instrument be turned off during recorder connection.

4. APPLICATIONS

a. Audio Level Measurements

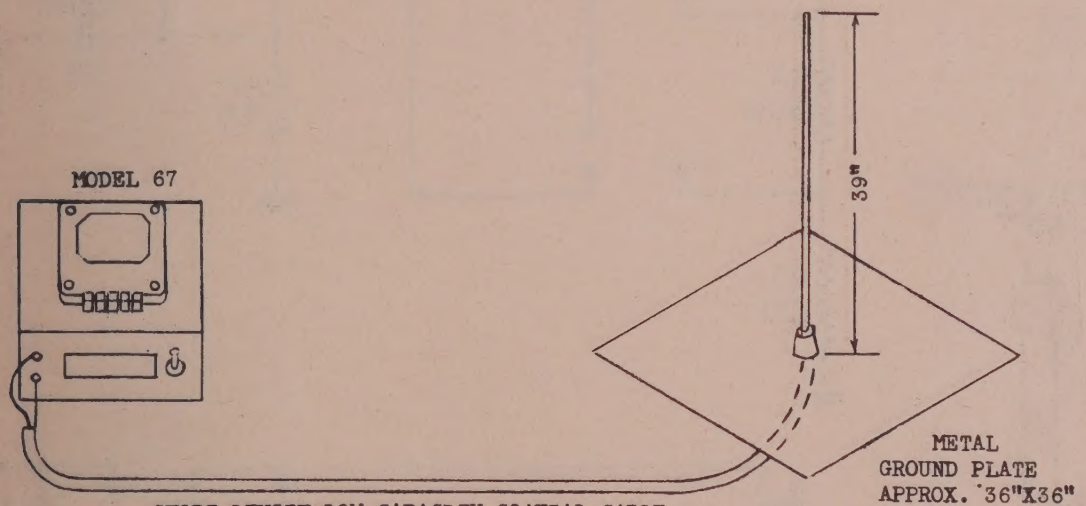
The Model 67 is ideally suited for monitoring audio level when cutting electrical transcriptions to prevent overcutting into the adjacent groove, since the peak to peak signal is a limiting factor in disc recording. The long discharge time constant of the Model 67 permits easy reading of the meter.

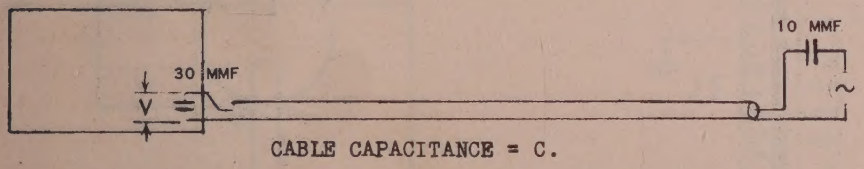
In monitoring AM or FM broadcast transmitters, it is the peak to peak audio signal level which must be kept within legal limits in order to avoid distortion and interference. Complex waves, involving speech and music, have considerably higher peak to peak levels than average or r.m.s. meters indicate. Accurate peak monitoring is therefore possible with the Model 67.

b. Video Level Measurements

In monitoring television video signals prior to mixing, it is customary to use an oscilloscope. This is both tiresome and inconvenient. The Model 67 offers a direct reading video level meter with optional use of a recorder as a permanent graphic record. The Model 67 is light, compact, and readily adapted to remote television pick-up applications, television relay equipment, and measurements at the television transmitter.

By the use of a sampling diode at the television transmitter antenna, a continuous

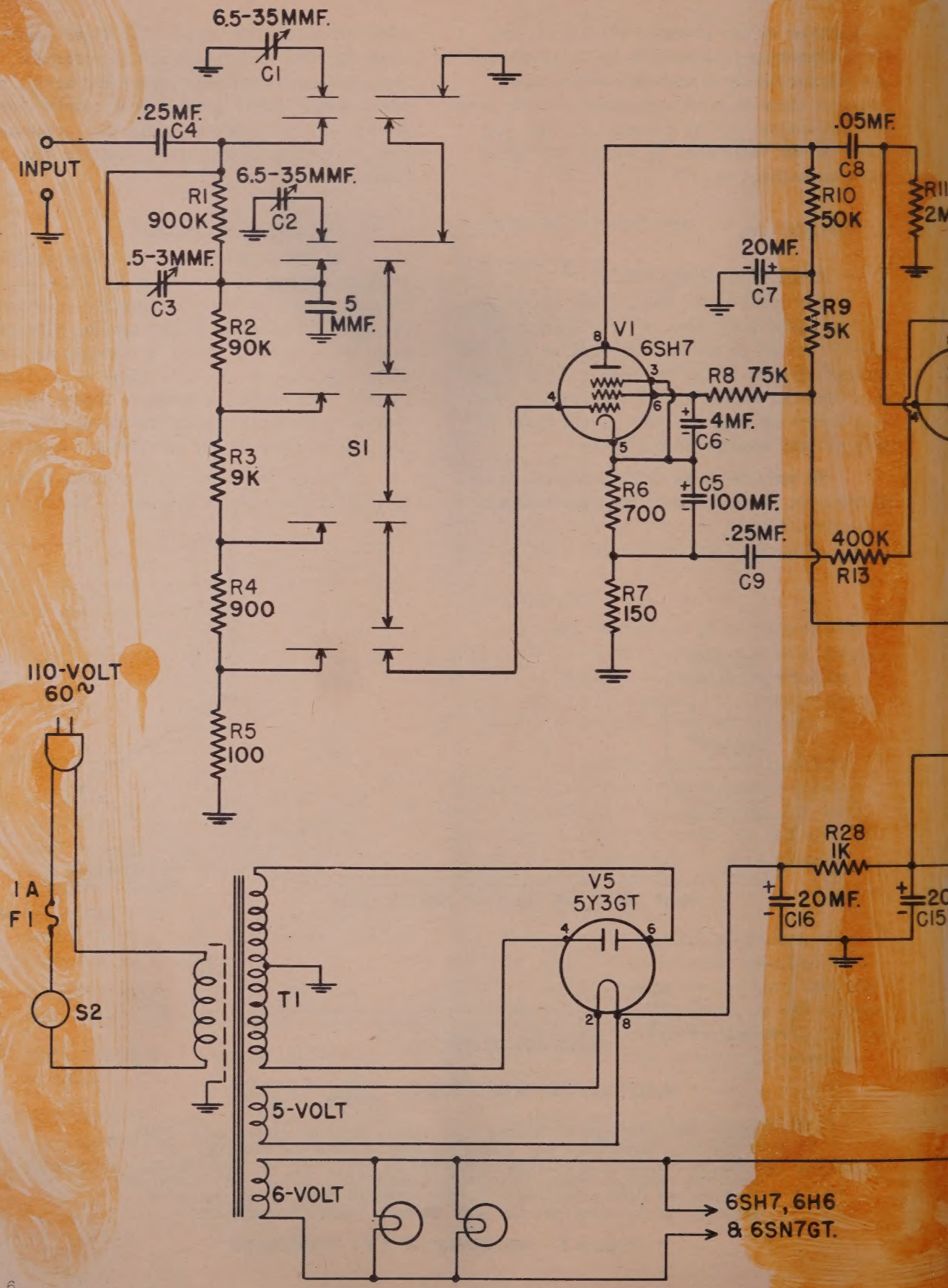


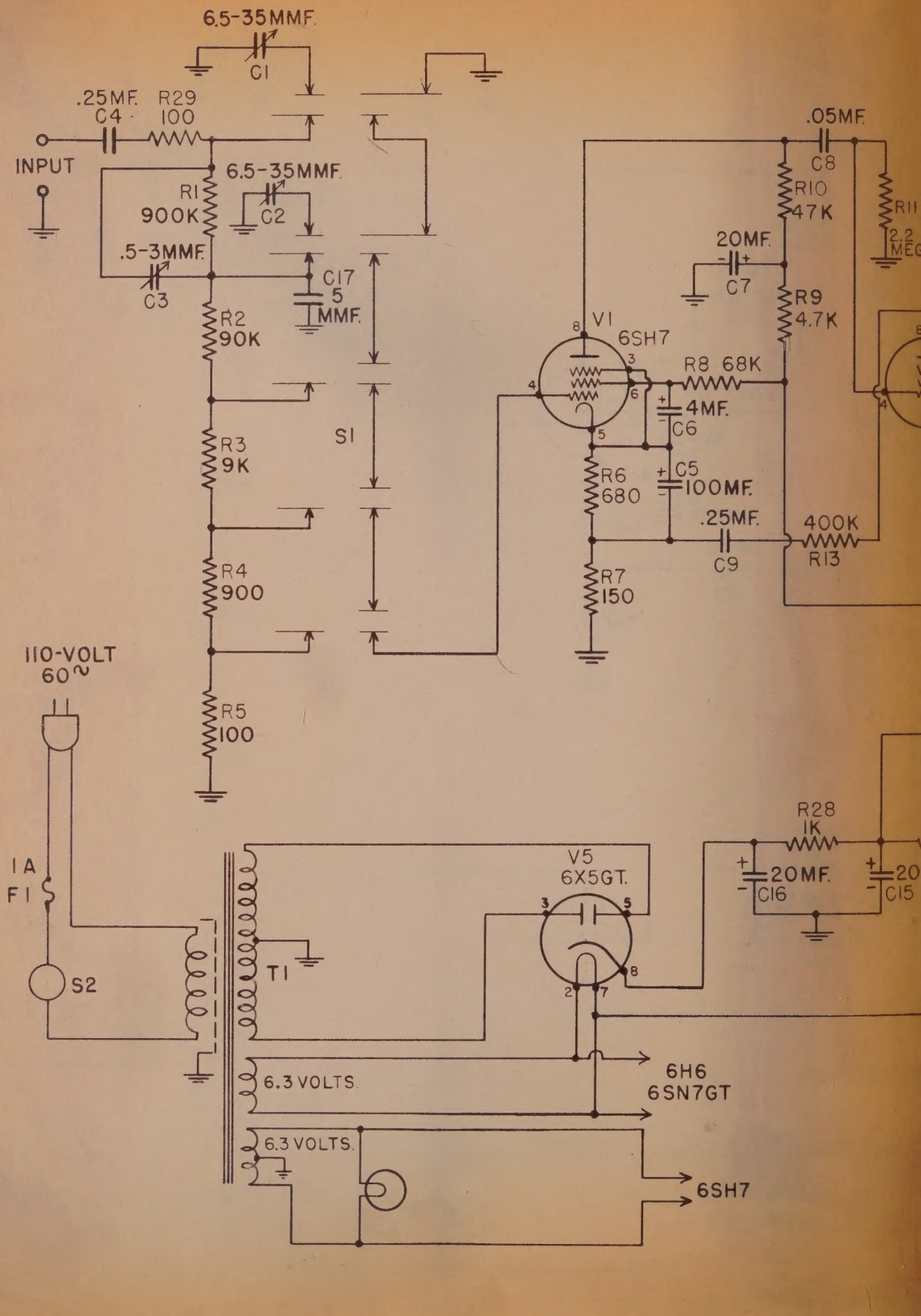


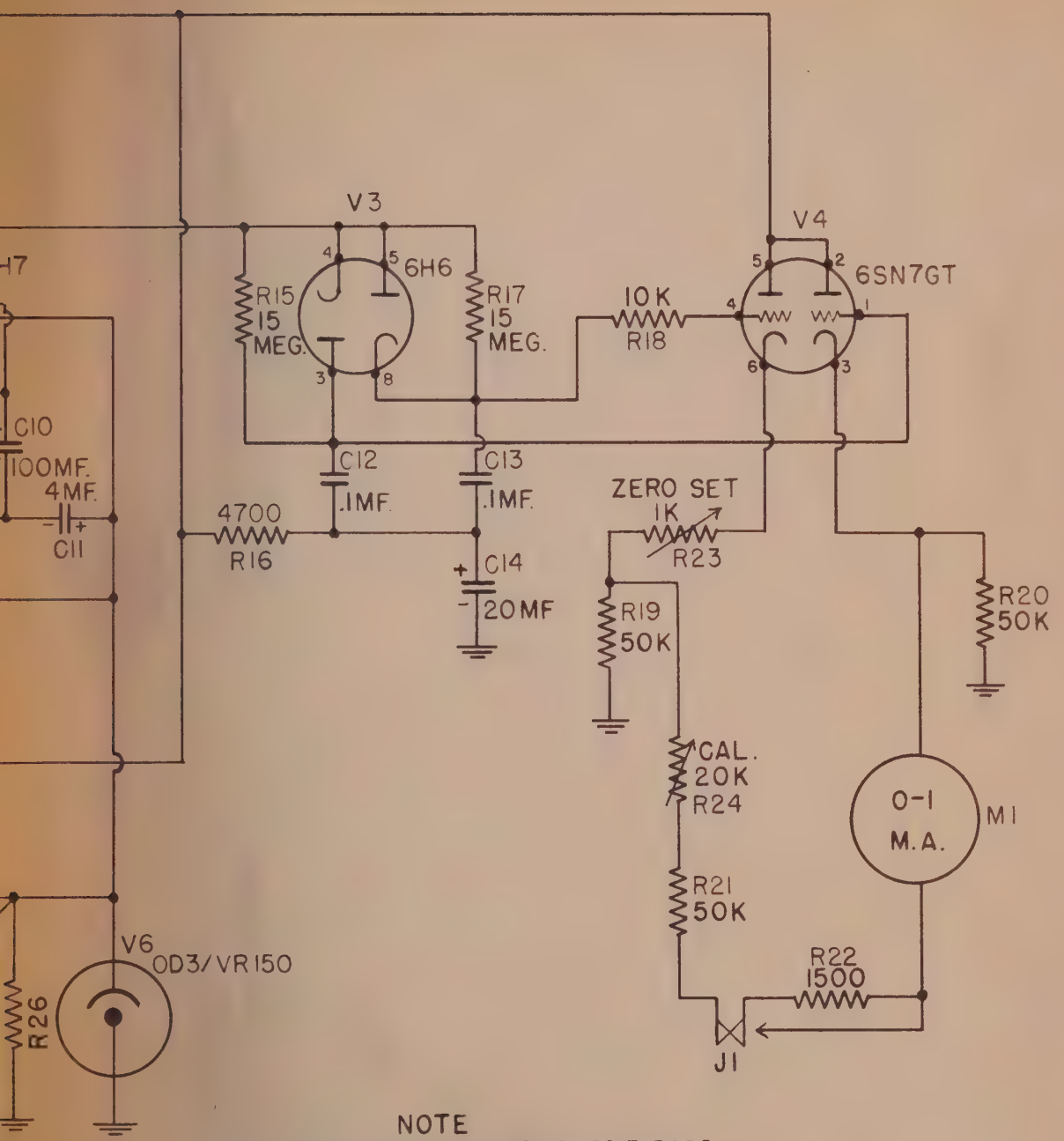
$$\text{MILLIVOLTS PER METER} = V \times 2 \times \frac{\cancel{10}}{\cancel{(30+C)}} \quad \frac{(40+C)}{10}$$

NOTE: The presence of strong a.c. fields from 60 cycle power lines or radio transmitters may cause too high a residual reading. If such is the case, a shielded room may be necessary in order to reduce the residual stray pick-up to a negligible value. At these low frequencies cavity resonance in the screened room should not be a problem, as is sometimes the case at much higher frequencies.

Figure 2 - MEASUREMENT OF R.F. INTERFERENCE


6.5-35MMF.
C1
.25MF.
C4
INPUT
6.5-35MMF.
C2
R1
900K
.5-3MMF.
C3
5
MMF.
R2
90K
R3
9K
R4
900
R5
100
S1
.05MF.
C8
R10
50K
20MF.
C7
R9
5K
V1
6SH7
R8 75K
4MF.
C6
R6
700
C5
100MF.
.25MF.
C9
400K
R13
R7
150
110-VOLT
60~
1A
F1
S2
T1
V5
5Y3GT
R28
1K
20MF.
C16
5-VOLT
6-VOLT
6SH7, 6H6
& 6SN7GT.

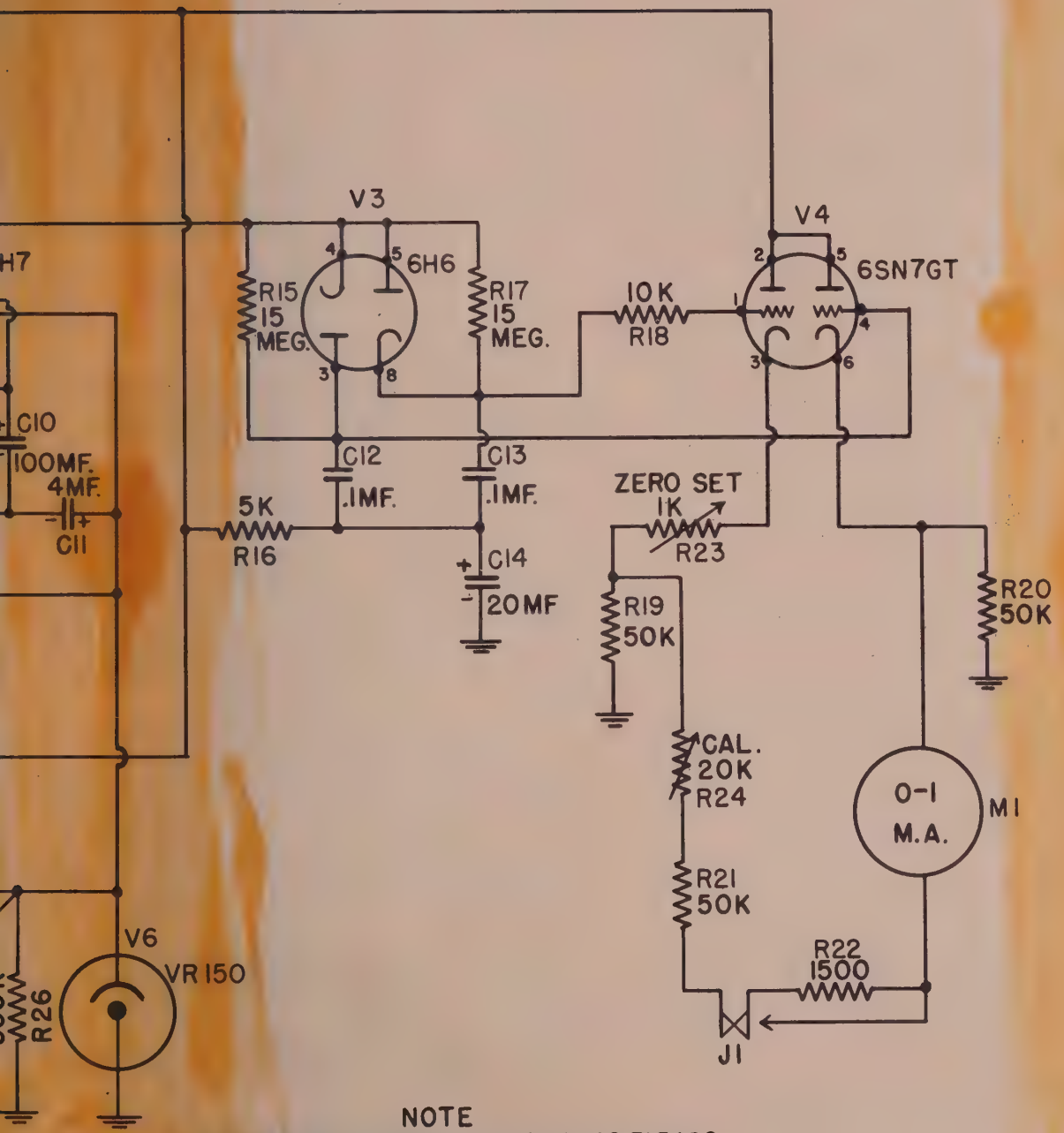

6.5-35MMF.
C1
.25MF.
C4
R29
100
INPUT
R1
900K
6.5-35MMF.
C2
.5-3MMF.
C3
C17
5
MMF.
R2
90K
R3
9K
R4
900
R5
100
S1
110-VOLT
60~
1A
F1
S2
T1
6.3 VOLTS.
6.3 VOLTS.
6H6
6SN7GT
6SH7
V5
6X5GT.
20MF.
C16
R28
1K
20
C15
.05MF.
C8
R10
47K
R11
2.2
MEG
20MF.
C7
R9
4.7K
V1
6SH7
R8 68K
4MF.
C6
C5
100MF.
R6
680
.25MF.
C9
400K
R13
R7
150



NOTE

CAPACITOR VALUES IN MICRO-MICRO FARADS AND RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED (K=X1000)

FIG.-3—WIRING DIAGRAM, MODEL-67.



NOTE

CAPACITOR VALUES IN MICRO-MICRO FARADS AND RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED (K=X1000)

Figure 3 - WIRING DIAGRAM, MODEL 67

recording of peak to peak video modulation can be made for further reference.

c. Measurement of Audio Electrical Interference

With the advent of FM with wide range audio response requiring better than usual transmission lines, amplifiers, etc., a noise containing low average energy but high peak energy assumes greater significance. The Model 67 is most convenient for measurement of signal to peak noise ratios, since these ratios can be read directly on the meter.

d. Measurement of Radio Interference

The Model 67 can be used with a small antenna to measure radio interference, particularly the impulse type originating in ignition systems. It is suggested that a one meter antenna be connected through a short shielded cable to the input terminals. The one meter antenna will have a capacity of approximately 10 mmfd. which, with the capacity of the input cable and the 30 mmfd. internal capacity of the instrument forms a simple capacity attenuator.

The effective height of a one meter vertical rod above a ground plane is approximately ½ meter; therefore, the field strength in microvolts per meter should be multiplied by two after correction has been made for the input capacity as shown in Figure 2.

Since the Model 67 will measure peak value of a pulse lasting only a few microseconds, much time can be saved suppressing vehicles and other impulse noise producing devices by the use of the Model 67 for measuring the radiated pulse.

e. Stress and Strain Measurements

In the past it has been customary to read r.m.s. or average values of the electrical output from strain gauges, and in some cases oscilloscopes or continuous recording of the wave shape have been made to determine the peak to peak stress range. The Model 67 now permits a direct reading of peak values and recording of peaks only, thus saving time in the determination of the peak stress range.

A recorder in conjunction with the Model 67 can also be used to plot a peak stress vs. displacement as well as time or other independent variables.

A sensitive peak voltmeter finds numerous application in many fields of science and industry, wherever peak to peak value of wave shape is of importance. Our Model 67 offers a new direct reading advantage over previous methods.

5. SERVICE AND MAINTENANCE

a. Replacement of Tubes

Vacuum tubes in the Model 67 are operated conservatively and should provide long service life. Occasionally, however, some zero shift may occur, or one of the 6SH7s may become somewhat microphonic and thus sensitive to mechanical vibration, or some other reason may make it necessary to replace tubes. In general, there will be less than 2% error occasioned by replacement of tubes. It may be necessary to readjust zero set control R23 as mentioned under Section B below when changes are made in the 6H6 or the 6SN7GT.

After replacing the 6SN7, the zero should be reset and then checked 3 or 4 hours later. Drift should be no more than the width of the zero lines. 6SN7s which drift beyond the range of the zero set should be discarded as aging will not return them to normal.

If it is necessary to change the 6SH7 tubes, it is well to select one having low microphonic response. This can be determined by tapping the instrument case with the fingers and noting whether the reading is less than a few scale divisions. Note that the setting of the attenuator has no effect on microphonic response, since it is ahead of all tubes.

b. Zero Adjustments

If the meter does not read substantially zero when the input terminals are shorted, R23 (as shown in Figure 4) should be

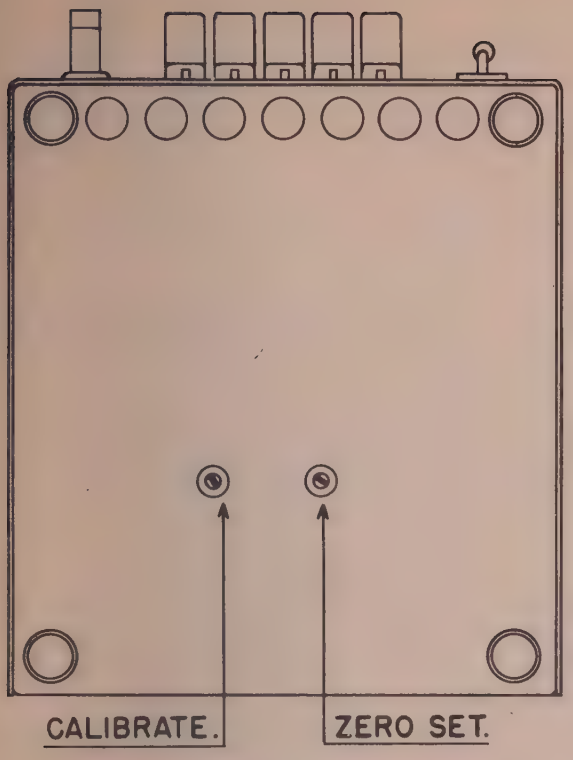


Figure 4 - BOTTOM VIEW OF MODEL 67

readjusted for zero reading of the meter. Before this is done, it is always well to replace both the 6H6 and 6SN7 with new tubes which have been aged for several days at normal heater potentials to be sure that this does not correct the zero.

Thorough engineering study and development of the Model 67 has largely reduced effects of humidity on zero adjustment; however, under abnormal circumstances such effects may affect the zero stability. This can be readily determined by warming up the entire instrument to 100° F. and noting whether the meter returns to zero. If serious humidity effects are present that cannot be eliminated by changing tubes, it is suggested that the instrument be returned to the factory along with a note as to the magnitude of the difficulty.

c. Calibration.

Sufficient negative feedback has been employed so that under normal circumstances it is not necessary to recalibrate when tubes are replaced with those of normal characteristics. However, if recalibration should be necessary, it is suggested that a sine wave of 100 volts having less than 2% harmonic content be applied to the input with the X10,000 button depressed. The calibration control R24 as shown in Figure 4, should be adjusted for full scale deflection. It is advisable then to reduce the applied voltage to 10 volts and push the X1,000 button to check the first attenuator step. Successive reduction in input should be made until all steps have been checked down to X1. If difficulties are experienced with the attenuator steps, it is suggested that the factory be contacted for a replacement resistor, since the distributed inductance and capacity of these units is important for proper high frequency response. High frequency compensation of the attenuator is made at the time the instrument is manufactured through the adjustment of C_1, C_2, and C_3. It should not be necessary to readjust these unless major changes in the attenuator response are made, such as replacement of the attenuator switch. If these adjustments are required, it is preferable to return the instrument to the factory, where specialized equipment will facilitate a first-class repair.

A variation in low frequency compensation as a result of defective electrolytics or filters may cause either a rise or fall in the response to a 5 cycle sine wave. It is suggested that the instrument be returned to the factory for repair, if substitution of new electrolytics does not cure the difficulty.

Excessive response of the instrument to line voltage surges has been minimized through the use of compensation network R_{16} and C_{24}. Substantial changes in the value of either component may upset this compensation and render the instrument susceptible to line voltage surges. These surges are not completely eliminated by the VR150.

d. Replacement of Meter Illuminating Lamps

These lamps can be replaced by removing the four mounting screws of the meter and lifting it out of the case so that the lamp will be accessible. These lamps are Mazda Type #44.

e. Fuse

The 1 ampere, Bussmann Type 3AG fuse is

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accessible through the rear of the cabinet adjacent to the recorder plug assembly. Repeated blowing of this fuse indicates a probable short circuit in the power transformer, A, or B supply of the system. Under no circumstances should this fuse be replaced with a larger fuse, as the instrument may be seriously damaged and major repair required as a result.

6. ACCURACY

The frequency response of the instrument is substantially flat to ±2% between 10 and 100,000 cycles. The indication of the instrument on a sine wave is accurate to within ±10%. Over a major portion of the instrument scale considerably better accuracy than 10% can be obtained.

Complex wave performance depends on mark/space ratios. For pulses of more than 5 microseconds duration, the following responses are obtained:

Mark/Space	Meter Error
1/1 (square wave)	+10%
1/20	+ 2%
1/200	-10%
1/1000	-30%

Time Constants:

1.5 milliseconds charge time - 1500 milliseconds discharge time.

Less than 2% error will be incurred with respect to line voltage change from 110 to 120 volts. Tube aging or replacement affects the accuracy by less than 2%.

Correlation between different Model 67's on complex waves having mark/space ratios of less than 1/200, may indicate readings differing as much as 10%. This is chiefly due to the effect of vacuum tubes on the charge time constant. Special selection of the tubes will assure closer correlation if required.

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